

## CLAIMS

### WHAT IS CLAIMED IS:

1. An instrument comprising:
  - exactly one tube that receives a sample fluid having a density;
  - a rigid pressure housing enclosing said tube and forming an annular area between said tube and said pressure housing;
  - a vibration source attached to said tube;
  - exactly one vibration detector attached to said tube; and
  - a measurement module electrically coupled to said vibration source and said vibration detector, wherein the measurement module is configured to determine a density of the sample fluid using a resonant frequency of the tube,wherein said vibration detector comprises:
  - a first magnet mounted to said tube wherein said first magnet has a first magnetic field;
  - a second magnet mounted to said first magnet wherein said second magnet has a second magnetic field that opposes the first magnetic field;
  - a first coil winding mounted to said pressure housing; and
  - a second coil winding mounted to said pressure housing adjacent to said first coil.
2. The instrument of claim 1 wherein said first coil winding and said second coil winding have axes of symmetry that align with axes of symmetry of said first and second magnets.
3. The instrument of claim 1 wherein a plane defined between said coiled windings is

aligned with a plane defined between said first and second magnets.

4. The instrument of claim 1 wherein said coil windings are phased in opposition so as to minimize voltage generated by external magnetic fields.

5. An apparatus for determining the resonance frequency of a tube comprising:

a vibration generator comprising:

a first magnetic core attached to the tube; and

a first coiled winding attached to a rigid housing; and

a vibration detector comprising:

a second magnetic core attached to the tube; and

a second coiled winding attached to the rigid housing,

wherein said second magnetic core is comprised of a first magnet and a second magnet arranged so that their axes of symmetry align and their magnetic fields repel,

wherein said second coiled winding comprises two coiled windings mounted end-to-end with symmetry axes aligned and electrically connected in series, and

wherein a plane defined by the intersection of the first magnet and second magnet is aligned with a plane defined by the intersection of the two coiled windings.

6. A method for characterizing a fluid comprising:

receiving a fluid sample of a first fluid at a first temperature and first pressure into a sample tube of a measurement device;

determining a first resonant frequency of the sample tube;

receiving a fluid sample of a second fluid at a first temperature and first pressure into the sample tube of the measurement device;

determining a second resonant frequency of the sample tube;

receiving a fluid sample of a third fluid at a second temperature and second pressure into the sample tube of the measurement device;

determining a third resonant frequency of the sample tube; and

calculating a density of the third fluid using the third resonant frequency and compensating for any difference between the first temperature and second temperature and the first pressure and second pressure.

7. An instrument comprising:

no more than one tube that receives a sample fluid having a density;

a rigid pressure housing enclosing said tube and forming an annular area between said tube and said pressure housing;

a vibration source attached to said tube;

no more than one vibration detector attached to said tube; and

a measurement module electrically coupled to said vibration source and said vibration detector, wherein the measurement module is configured to determine a density of the sample fluid using a resonant frequency of the tube.

8. The instrument of claim 7 wherein said vibration detector comprises:

a first magnet mounted to said tube wherein said first magnet has a first magnetic field;

a second magnet mounted to said first magnet wherein said second magnet has a second

magnetic field that opposes the first magnetic field;

a first coil winding mounted to said pressure housing; and

a second coil winding mounted to said pressure housing adjacent to said first coil.